National Aeronautics and Space Administration

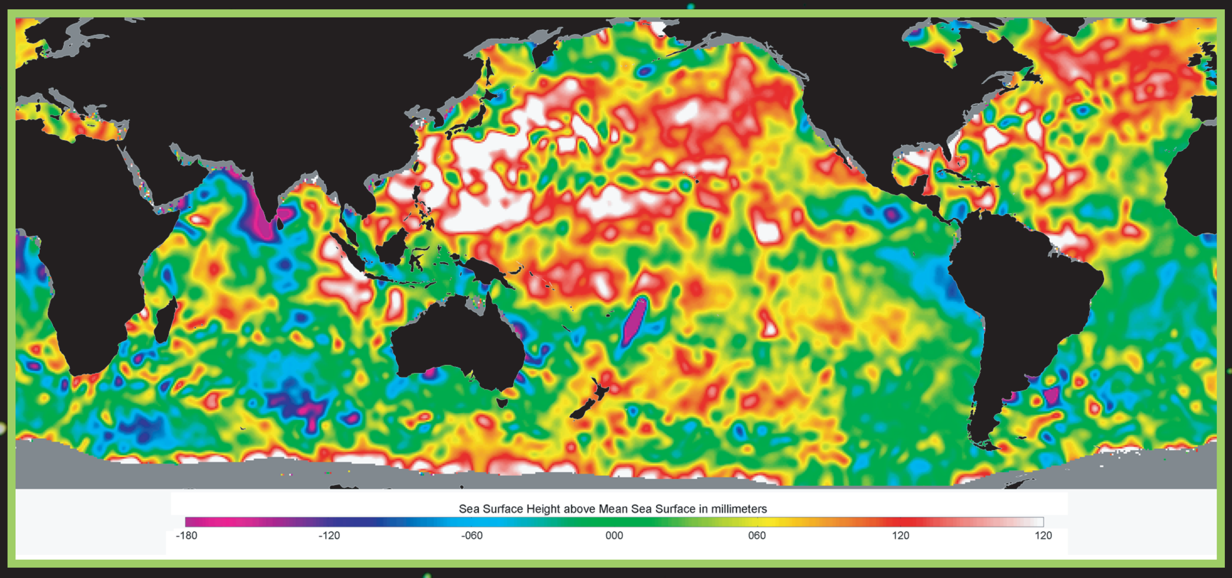
GEODESY

Measuring Earth

NASA satellites measure the size and shape of Earth, as well as its gravity field, using modern geodetic techniques such as laser and radar altimetry, interferometric synthetic aperture radar, and satellite-to-satellite ranging. Remote sensing technologies are empowering scientists to measure and understand subtle changes of the surface and interior, which reflect the response of Earth to internal forces, sea-level change, and climatic forces.

Sea Surface Height

Ocean currents flow around highs and lows of oceanic pressure that can be determined from the height of the sea surface, called ocean surface topography. Ocean current velocity can thus be computed from the slope of the ocean surface. This Jason Global Near-Real Time Sea Surface Height Anomaly image shows the variations in the sea surface height for 9/4/2005–9/14/2005.

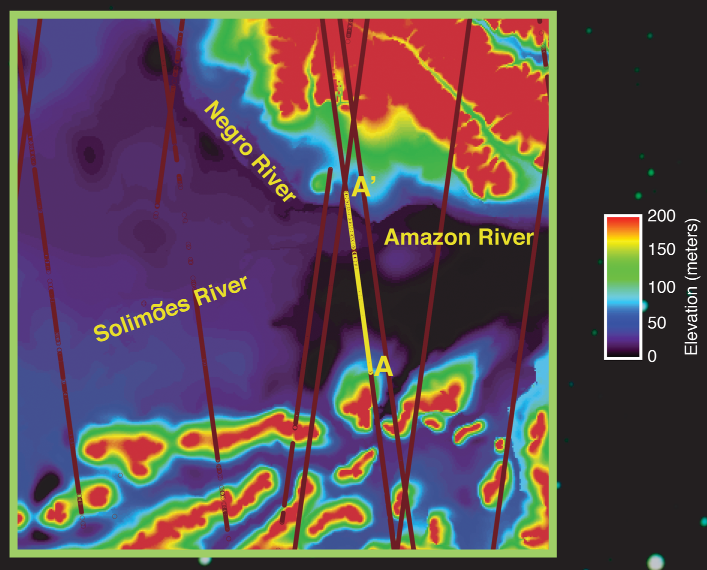


Jason (radar altimetry) Sea Level Residuals

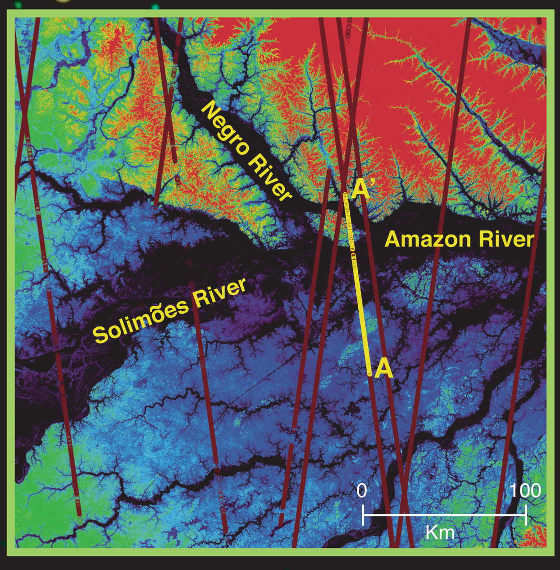
Image Credit: NASA/JPL/PO.DAAC

Land Elevation

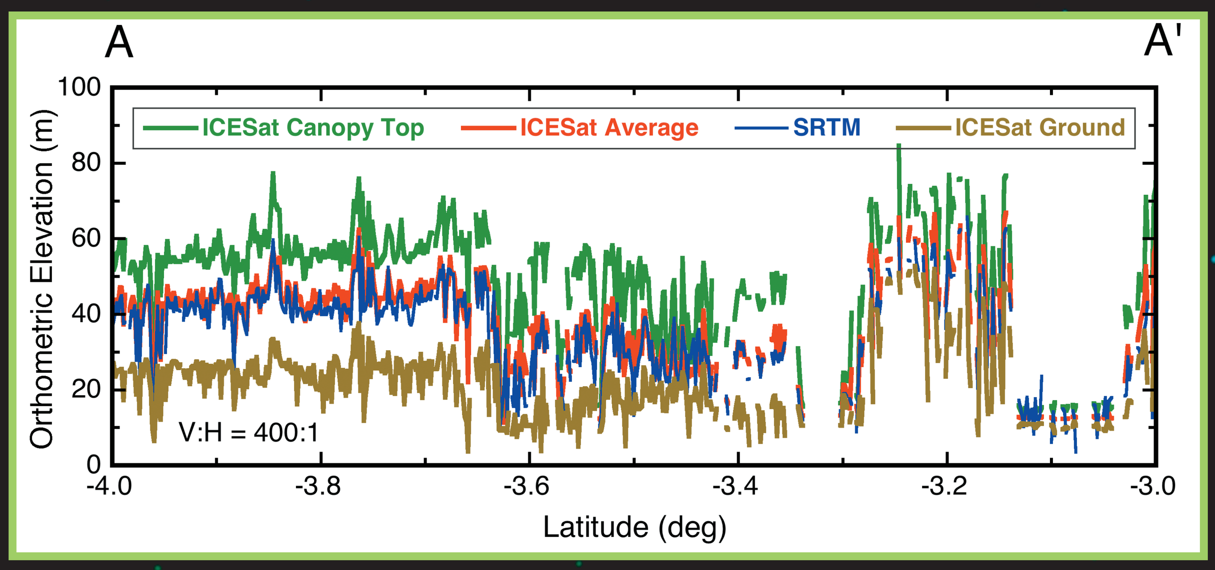
The improvement to topographic maps achieved using satellite data is shown by comparing a Shuttle Radar Topography Mission (SRTM) map of the Central Amazon Basin to GTOPO-30, the best publicly available, global topography data prior to SRTM. In addition, new laser altimeter measurements from the Ice, Cloud, and land Elevation Satellite (ICESat) can distinguish between ground and vegetation heights. The SRTM radar elevation is compared to the laser canopy top-, average-, and ground elevations for a portion of an ICESat track (A-A').



GTOPO-30 pre-2000
900 m pixels; ~100 m vertical accuracy



SRTM Feb. 2000
90 m pixels; ~10 m vertical accuracy

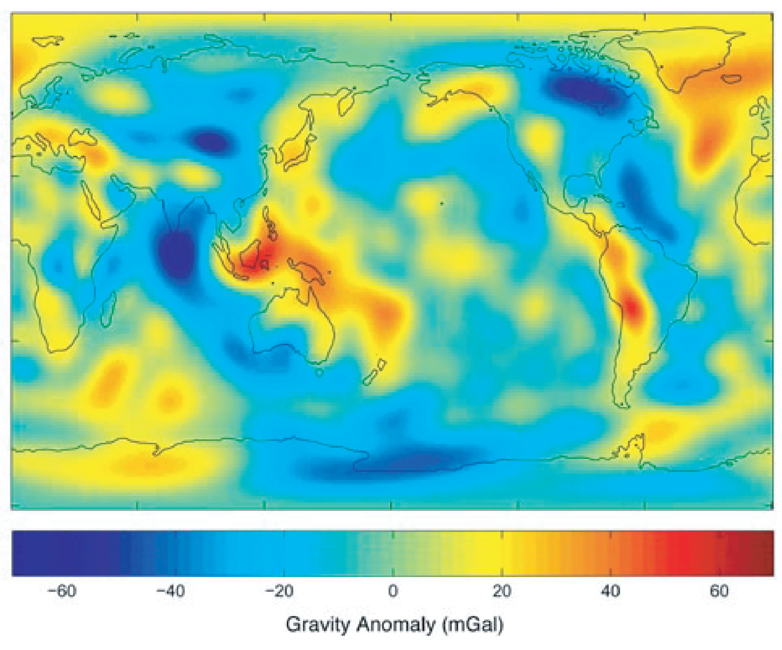


ICESat profile acquired November 7, 2004
65 m footprint; 172 m apart (tracks overlaid on images; gaps due to clouds)
~0.1 m to ~1 m vertical accuracy

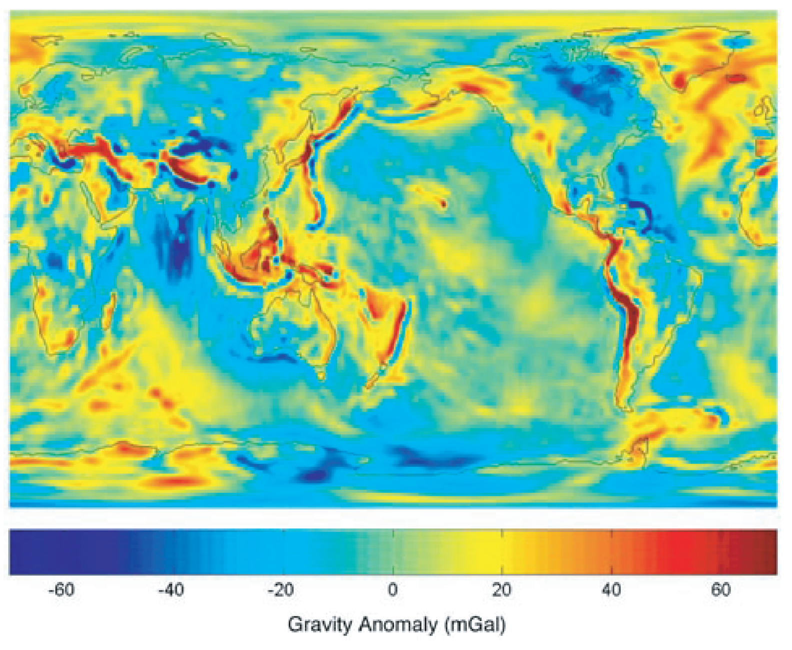
Images Courtesy of the NASA ICESat Science Team

Gravity

The new Gravity Recovery and Climate Experiment (GRACE) satellite-to-satellite ranging measurements provide gravity field model improvements, which allow scientists to more accurately infer Earth's internal structure at finer resolution than ever before possible from space.

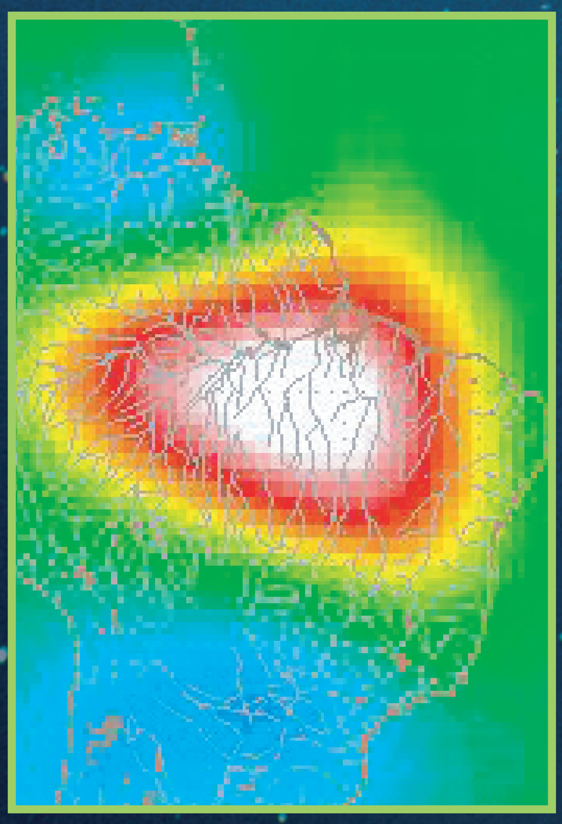


Gravity anomalies from decades of tracking Earth-orbiting satellites

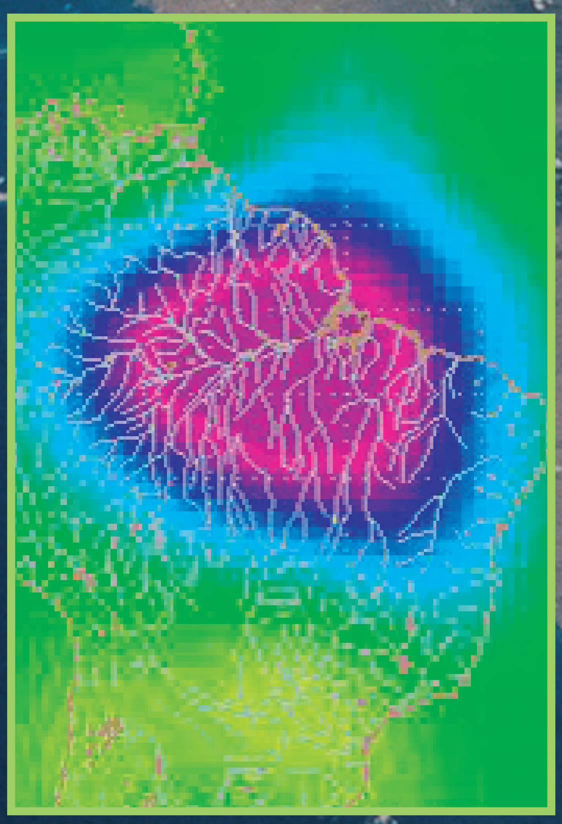


Gravity anomalies from 363 days of GRACE data (GGM02S)

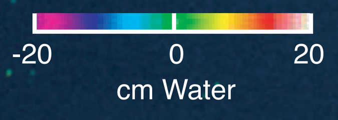
Image Credit: University of Texas Center for Space Research and NASA



Wet Season



Dry Season



Images courtesy of the NASA/JPL/GRACE Tellus Project

Water Reservoirs

Changes in gravity may be caused by changes in water storage in hydrologic reservoirs. The Amazon Basin water content varies greatly between wet and dry seasons. These GRACE images show monthly changes in equivalent water thickness demonstrating how water can be monitored from satellites.

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